

SECTION 0501

METALS

0501.0100 GENERAL

0501.0101 Description of the Work. The work under this Section shall consist of furnishing and installing materials including, but not limited to, the following:

- Aluminum and miscellaneous nonferrous metals
- Anchors and anchor bolts
- Bolts
- Grating and frames
- Hatches
- Ladders
- Manhole frames and covers
- Metal roof decking
- Miscellaneous aluminum
- Miscellaneous cast iron
- Miscellaneous metal items shown on the plans or special provisions
- Miscellaneous structural steel
- Pipe handrails, pipe sleeves, inserts, and gates
- Shade structures
- Sheet metalwork
- Stairs and treads
- Structural steel
- Supports for mechanical equipment
- Tread plates and frames

0501.0103 Submittals. Before moving any materials to the site or commencing any work in the section, the Contractor must submit 5 copies for the Engineer's approval. No materials will be allowed on site without this approval.

0501.0105 Testing or Special Inspections. It is the Contractor's responsibility to schedule required testing per specifications, contract, plans, and special provisions. All required testing must be coordinated by the Contractor; failure to schedule required tests will result in rejected work at the Contractor's sole expense.

0501.0200 PRODUCTS

0501.0202 Materials.

(A) Standards. Unless otherwise specified or indicated on the plans or TW Standard/Typical Details, structural and miscellaneous metals shall conform to the latest revision of the ASTM standards, including but not limited to the following:

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**Table 0501-1
ASTM Standards**

Material	Item	ASTM Standard	Class, Grade, Type, or Alloy Number
	Galvanized sheet iron or steel	A446 A525 A526	Coating G90 (min.)
	Structural steel	A36	--
	Standard bolts, nuts, and washers	A307	--
	High-strength bolts, nuts, and washers	A325	--
	Tubing, cold-formed	A500	--
	Tubing, hot-formed	A501	--
	Black steel, sheet or strip	A569 A570	--
	Coil (plate)	A635	--
	Steel pipe	A53	Grade B
	Plate, sheet, and strip	A167	Type 304 or 316
	Bars and shapes	A276	Type 304 or 316
	Sheet aluminum—flashing	B209	Alloy 5005-H14, min. 0.032 inches thickness
	Sheet aluminum—structural	B209	Alloy 6061-T6
	Structural aluminum	B221	Alloy 6061-T6 B209
	Extruded aluminum	B221	Alloy 6063-T42
Cast Iron	Cast iron	A48	Class 40B

Other structural and miscellaneous metal items shall be as indicated on the plans, TW Standard/Typical Details, or as specified.

0501.0300 EXECUTION

0501.0301 General. All fabrication and erection of steel items shall conform to the AISC “Specification for Structural Steel Buildings” wherever applicable, except as may be modified by applicable building codes and specifications, of which this is a part.

Where anchors, connections, or other details of miscellaneous metalwork are not definitely indicated or specified, their material, size, form, attachment, and location shall be equivalent in quality and workmanship to items as specified herein.

Galvanized structural steel or iron shall be “hot-dip” galvanized after fabrication in accordance with ASTM A123. Electro-galvanizing shall not be used unless specified. Galvanized items that bend or twist during galvanizing shall be re-straightened to ASTM A6 dimensional tolerances.

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All bolts shall be provided with washers and self-locking nuts, or lock washers and plain nuts. Bolts—including anchor bolts—nuts, washers, and similar fasteners specified to be galvanized, shall be galvanized after cleaning in accordance with ASTM A153. All bolts, including anchor bolts and concrete anchors, shall project beyond the attached nut(s) a minimum of 2 threads and a maximum of 1/2 inch.

All cut or otherwise damaged galvanized surfaces shall be field repaired to equivalent original condition using Galvinox, Galvo-Weld, or equal.

The Contractor shall take all measurements necessary to properly fit the work in the field. The Contractor shall be governed by, and be responsible for, these measurements and the proper working out of all details. The Contractor shall also be responsible for the correct fitting of all metalwork in the field. Sharp or hazardous projections shall be rounded off and ground smooth. The Contractor shall paint steel and miscellaneous ferrous metal items in accordance with these specifications.

Where aluminum comes in contact with dissimilar metals, it shall be bolted with stainless-steel bolts and separated or isolated from the dissimilar metals—as well as the stainless-steel bolts and nuts—with neoprene gaskets, sleeves, and washers. Those parts of aluminum that will be cast into concrete or come into contact with concrete, masonry, or wood shall be coated in accordance with these specifications.

All stainless-steel bolt and screw surfaces shall be coated with Never-Seez by Never Seez Compound Corp., WLR No. 111 by Oil Research Inc., or equal.

0501.0302 Installation.

(A) Structural Metal. All structural or foundry items shall be carefully fabricated to true dimensions without warp or twist. Welded closures shall be neatly made. Where weld material interferes with fit or is unsightly in appearance, it shall be ground off smooth.

Each structural item shall be installed accurately and securely true to level, plumb, alignment, and grade with all parts bearing or fitting the structure or equipment for which it is intended. Cocking out of alignment, re-drilling, reshaping, or forcing to fit any fabricated item will not be permitted. It is the Contractor's responsibility to place anchor bolts or other anchoring devices accurately, and to make any surfaces that bear against structural items smooth and true to level to preclude the necessity of any springing, re-drilling, or reshaping.

Structural items needing a special alignment to preserve straight, level, even, smooth lines shall be rigidly supported and braced, and kept braced until concrete, grout, or dry-pack cement mortar has hardened for at least 48 hours.

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The Contractor shall provide certified copies—in duplicate—of mill tests or reports from a recognized commercial laboratory regarding the chemical, tensile, and bending properties of each shipment of structural metal or part thereof having common properties. All tests and analyses shall be made in accordance with the applicable ASTM specification.

All welding under this Section shall be done by welders with a current AWS certificate for the type of welding to be done. The Contractor shall notify the Engineer at least 24 hours before starting shop or field welding. A welding inspector may check the materials, equipment, and qualifications of the welders. Welders doing unsatisfactory work shall be removed from work on this project or may be required to requalify at the Contractor's expense.

The inspector may use, on any part or weld, any aid to visual inspection—including but not limited to gamma ray, magnetic particle, dye penetrant, and trepanning—that is deemed necessary to ensure adequacy of the welds.

All tests, including retests on defective welds, shall be at the Contractor's sole expense. Any costs incurred in connection with qualifying welders shall also be paid by the Contractor.

(B) Structural Steel. The Contractor shall furnish and install all structural steel items in accordance with the plans and TW Standard/Typical Details, and as specified herein. The Contractor shall provide all supplementary parts necessary to complete each item even though such work is not definitely covered by the plans and specifications.

All structural steel shall be delivered free from mill scale, rust, or pitting. Items not galvanized or protected by a shop coat of paint shall be protected from the weather until erection and painting.

Welding steel shall conform to AWS D1.1.

All welds shall be full penetration welds, unless specified otherwise.

All welding of structural steel type ASTM A36 shall be done using electrodes conforming to AWS A5.1, or using electrodes and fluxes conforming to AWS A5.17, using an F7XX-EXXX electrode-flux combination. AWS D1.6 should be used for welding stainless-steel structures. Whenever contract documents specify AWS D1.1 for welding stainless steel, the requirements of AWS D1.6 shall apply.

(C) Anchor Bolts and Inserts. Wherever feasible, anchor bolts shall be cast in place when concrete is placed. Anchor bolts, concrete anchors, and flush shells embedded in concrete shall be accurately spaced with bolts truly normal to the surfaces from which they project.

Anchor bolts and nuts shall be type 316 stainless steel when:

- Submerged in water

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- Located below the tops of the walls, as in structures customarily containing water, even if above water level
- In ceilings or overheads
- In the dry side of water-bearing walls
- Used to secure aluminum to steel or concrete equipment

Other anchor bolts not required to be of stainless steel shall be stainless steel or galvanized carbon steel conforming to ASTM A307 or ASTM A36.

Anchor bolts shall not touch reinforcing steel. Where anchor bolts are within 1/4 inch of reinforcing steel, anchor bolts shall be insulated with no less than 3 wraps of 10-millimeter PVC tape in the area adjacent to the reinforcing steel.

When anchoring machinery bases subject to heavy vibration, the Contractor shall use 2 nuts, with 1 serving as a locknut. All bolts, when indicated for future use, shall be first coated thoroughly with non-oxidizing wax, followed by turning nuts down to the full depth of thread. Exposed thread shall then be neatly wrapped with waterproof polyvinyl tape.

Unless indicated otherwise on the plans, anchor bolts shall be embedded a minimum of 12 diameters and shall have a head or a hook at least 4 diameters in length. Where indicated on the plans, anchor bolts shall be set in metal sleeves with an inside diameter approximately 2 inches greater than the bolt diameter and no less than 12 bolt diameters in length. Sleeves shall be filled with grout when the machine or other equipment is grouted in place.

(D) Concrete Anchors. Concrete anchors, where indicated on the plans or special provisions, shall mean drilled-in-place anchors with integral anchor bolts. Concrete anchors shall be ITT-Philips Red Head "Wedge Anchors" with integral anchor bolts, Expansion Products Company "Wej-It" concrete anchors with integral anchor bolts, or equal.

The material of each concrete anchor, including its integral anchor bolt, washer, and nut, shall be type 304 or 316 stainless steel.

Concrete anchors shall be not less than 1/2 inch in diameter and shall have the following minimum embedment lengths:

**Table 0501-2
Embedment Lengths for Concrete Anchors**

Size (Inches)	Embedment Length (Inches)
1/2	2-1/4
5/8	2-3/4
3/4	3-1/4

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Prior to installing or using concrete anchors, the Contractor shall perform the following test with results subject to review and acceptance by the Engineer. The Contractor shall do the following tasks:

- (1) Furnish at least four 5/8-inch concrete anchors, type 304 or 316 stainless steel, whichever type is proposed for use.
- (2) Install the concrete anchors in a test block of concrete to the specified embedment length.
- (3) Furnish and install one 5/8-inch nut on each concrete anchor. Tighten each nut with an applied torque of 10 foot-pounds.
- (4) Loosen each nut, then retighten with an applied torque load of 10 foot-pounds.

Any visible evidence of turning of any of the concrete anchors shall be cause for the Engineer to reject the concrete anchors.

Anchor bolts may be cast in the concrete in lieu of using concrete anchors.

Cast-iron, lead-cinch, or slug-in anchors will not be accepted as substitutes for concrete anchors.